PHYTOGEOGRAPHY OF THE CARICES OF VIRGINIA

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The carices growing in Virginia include *Carex*, a large and cosmopolitan genus with a preponderance of species in temperate regions of the Northern Hemisphere, and the monotypic genus, *Cymophyllus*, endemic to the Southern Appalachians. *Carex* is by far the largest genus of vascular plants in Virginia, with 121 species recognized in this study. Each species of the carices is, as a rule, well-defined, has its own distributional pattern, and has particular ecological requirements. There are woodland, meadow, bog, marsh, swamp, rock, calcicolous, and arenaceous species. The geographic affinities of the native Virginia carices are circumboreal, Asiatic-American, and strictly American. Within the state of Virginia these species show most of the patterns occurring in other vascular plants.

During the course of this study, counties' records from voucher specimens were plotted on outline maps of Virginia, and these data will be published at a later date. Collections were studied at the College of Wiliam and Mary, Gray Herbarium, Lynchburg College, National Arboretum, New York Botanical Garden, University of North Carolina, Old Dominion University, Philadelphia Academy of Science, Smithsonian Institution, West Virginia University, Virginia Commonwealth University, and Virginia Polytechnic Institute. The writer is indebted to the respective curators for their generosity.

In general, I have taken a rather wide view of some species, for, until some of the closely related taxa are better understood, Joseph Hooker's rationale in his work on arctic plant distribution (1862) still seems most useful for phytogeographic purposes: "My main object is to show affinities of the polar plants, and I can best do this by keeping the specific idea comprehensive. It is always easier to indicate differences than to detect resemblances . . ."

This paper would have been much less complete but for the outstanding collections of Dr. Henry K. Svenson, mostly from our coastal plain; and those of Mr. Charles E. Stevens from many areas of the state, especially the higher levels on mountains of western Virginia. Four of Stevens' collections were new records for the state: *Carex brevior, C. pallescens, C. polymorpha,* and *C. rostrata.* Also, Dr. John Wurdack gave many helpful suggestions, Dr. Sydney McDaniel pointed out the Fernald-Long collection of *C. chapmanii,* and Dr. Svenson identified our specimen of *C. pallescens.*

For the most-frequently collected species, *C. lurida,* I have examined specimens from 83 of the 100 old counties of Virginia, counties before the incorporation of Elizabeth City, Norfolk, Princess Anne, and Warwick counties as the cities of Hampton, Norfolk and Chesapeake, Virginia Beach, and Newport News. On the other hand, eight species have apparently been collected in but a single county: *C. chapmanii,* Greensville; *C. extensa,* Norfolk; *C. pallescens,* Grayson; *C. polymorpha,* Rockingham; *C. rostrata,* Bath; *C. tetanica,* Sussex; *C. trichocarpa,* Washington; and *C. woodii,* Shenandoah County.

I have seen specimens for all included records with the exceptions of *C. biltmoreana* and *C. cherokeensis,* and these are based on the authority of the *Manual of the Vascular Flora of the Carolinas* (Radford, A. E., *et al.* 1968).

The 121 Virginia species of the carices grow in the following patterns:

1. Circumboreal.

C. brunnescens (Pers.) Poir.
C. buxbaumii Wahl.
C. canescens L. (also Australia)
C. lasiocarpa Ehrh.
C. muricata L.
C. pallescens L.
C. rostrata Stokes

2. North America and eastern Asia.

C. pedunculata Muhl.
C. pensylvanica Lam.

3. Ranging west to the Pacific Coast.

C. brevior (Dewey) Mackenz.
C. comosa Boott
C. eburnea Boott
C. hystricina Muhl.
C. interior Bailey
C. leptalea Wahl.
C. nigromarginata Schwein.
C. scoparia Schk.
C. stipata Muhl.
C. umbellata Schk.
C. vulpinoidea Michaux

4. Ranging southward beyond the United States.

C. albolutescens Schwein.
C. bromoides Schk.
C. lurida Wahl.
C. physorhyncha Lieb.

5. Extending inland to the Middle West.

a. Generally distributed in the north and south.

C. amphibola Steudel
C. artitecta Mackenz.
C. atlantica Bailey
C. blanda Dewey
C. caroliniana Schwein.
C. cephalophora Muhl.
C. complanata Torrey & Hooker
C. debilis Michaux
C. digitalis Willd.
C. emmonsii Dewey
C. festucacea Schk.
C. folliculata L.
C. frankii Kunth
C. granularis Muhl.
C. grisea Wahl.
C. howei Mackenz.
C. intumescens Rudge
C. jamesii Schwein.
C. laevivaginata (Küken.) Mackenz.
C. laxiflora Lam.
C. leavenworthii Dewey
C. lupuliformis Sartwell
C. lupulina Schk.
C. muhlenbergii Schk.
C. oligocarpa Schk.
C. retroflexa Muhl.
C. rosea Schk.
C. sparganoides Muhl.
C. *striatula* Michaux
C. stricta Lam.
C. styloflexa Buckley
C. tribuloides Wahl.
C. typhina Michaux
C. willdenowii Schk.

b. Generally northern in distribution.

C. albursina Sheldon
C. annectens Bicknell
C. argyrantha Tuckerm.
C. bushii Mackenz.
C. careyana Torrey
C. communis Bailey
C. conjuncta Boott
C. crinita Lam.
C. cristatella Britton
C. gracilescens Steudel

C. gracillima Schwein.
C. grayii Carey
C. hitchcockiana Dewey
C. laxiculmis Schwein.
C. leptonervia Fernald
C. normalis Mackenz.
C. plantaginea Lam.
C. platyphylla Carey
C. prasina Wahl.
C. scabrata Schwein.
C. shortiana Dewey
C. squarrosa L.
C. suberecta (Olney) Britton
C. swanii (Fernald) Mackenz.
C. tenera Dewey
C. tetanica Schk.
C. torta Boott
C. trichocarpa Muhl.
C. trisperma Dewey
C. virescens Muhl.

c. Generally southern in distribution.

C. cherokeensis Schwein.
C. crebriflora Weigand
C. flaccosperma Dewey
C. oxylepis Torrey & Hooker

d. Coastal plain and Mississippi Valey, extending westward in the northern states.

C. alata Torrey
C. decomposita Muhl.
C. hyalinolepis Steudel
C. seorsa Howe

e. Coastal plain and Mississippi Valley, extending westward in the south.

C. abscondita Mackenz.
C. crus-corvi Shuttl.
C. gigantea Rudge
C. glaucescens Elliott
C. joori Bailey
C. louisianica Bailey
C. reniformis (Bailey) Small

6. Limited to eastern North America.

a. Generally distributed north and south.

(1) Mostly on the coastal plain. *C. walteriana* Bailey.

(2) Mostly on the coastal plain but extending inland in the south.

C. barrattii Schwein. & Torrey
C. bullata Schk.
C. collinsii Nuttall
C. venusta Dewey

b. Plants mostly of northern distribution.

C. aestivalis M. A. Curtis
C. baileyi Britton
C. polymorpha Muhl.
C. vestita Willd.
C. woodii Dewey

c. Southern species. *C. chapmanii* Steudel

7. Southern Appalachian endemics.

C. biltmoreana Mackenz. *Cymophyllus fraseri* (Andrz.) Mackenz.

8. Introduced species.

C. arenaria L. Europe
C. divisa Hudson Europe
C. extensa Good. Europe
C. kobomugi Ohwi e. Asia
C. spicata Hudson Eurasia

It is clear from this analysis that the vast majority of Virginia species are limited in range to the eastern part of North America, and it is probable that most of them had their origin here. This picture is not a true representation of the Virginia flora as a whole, however, because, as stated earlier, the carices are predominantly species of temperate regions of the Northern Hemisphere. If the other genera of sedges were included in this study, the picture would more nearly approximate that of the entire flora because most of those genera have strong tropical affinities. Among their species are many aggressive, opportunistic types which are, nevertheless, virtually confined to our coastal plain. The piedmont here becomes a formidable barrier to the spread of these species, apparently because of topography (and lack of many types of habitats), soils, and even the vegetation itself. The closed oak-hickory-pine communities, growing on "tight," clayey soils, are not communities through which many species can spread (Braun, 1950, p. 510). Some of these relationships are strikingly brought out by the distributional patterns within Virginia.

Within the state of Virginia, *Carex intumescens* has the widest range of all the 121 species, growing not only at sea level near the coast, but across the state and to the top of Mt. Rogers at 5719 feet. At the other extreme are the seven native species, each known from a single county; and although some of them may very well turn up elsewhere, we can be sure that they have very narrow environmental tolerances.

The 116 native species show the following patterns within the state:

1. Generally distributed across the state. (44 species)

2. Coastal plain. (20 species)

C. barrattii
C. bullata
C. chapmanii
C. cherokeensis
C. collinsii
C. crus-corvi
C. decomposita
C. gigantea
C. glaucescens
C. howei
C. hyalinolepis
C. joori
C. louisianica
C. lupuliformis
C. oxylepis
C. reniformis
C. tetanica
C. venusta
C. vestita
C. walteriana

3. Piedmont. *C. bushii*

4. Coastal plain and piedmont. (7 species)

C. alata
C. comosa
C. conjuncta
C. emmonsii
C. grayi
C. typhina
C. umbellata

5. Mountains. (20 species)

C. aestivalis
C. albursina
C. argyrantha
C. biltmoreana
C. brevior
C. brunnescens
C. careyana
C. eburnea
C. hystricina
C. leptonervia
C. muricata
C. pallescens
C. pedunculata
C. polymorpha
C. rostrata
C. suberecta
C. trichocarpa
C. trisperma
C. woodii
Cymophyllus fraseri

6. Mountains and piedmont. (9 species)

C. communis
C. cristatella
C. hitchcockiana
C. interior
C. plantaginea
C. shortiana

C. sparganoides
C. torta
C. willdenowii

7. **Disjunct.** (15 species)

a. Coastal plain — mountains.

C. albolutescens
C. baileyi
C. bromoides
C. buxbaumii
C. canescens
C. folliculata
C. lasiocarpa
C. leptalea
C. oligocarpa
C. seorsa
C. virescens

b. Mountains — piedmont outlier (calcareous soils) *C. scabrata*

c. Mountains — piedmont outlier (calcareous soils) — coastal plain (on marl) *C. jamesii* and *C. prasina*

d. Mountains — coastal plain (connected via the northern piedmont) *C. swanii*

These data show that almost 13% of the 116 native species have ranges with major discontinuities. Those with the most pronounced breaks are the coastal plain — mountain disjuncts. Of these eleven species, three have their larger populations on the coastal plain: *C. albolutescens, C. folliculata,* and *C. seorsa.* Four are more widespread in the mountains: *C. baileyi, C. leptalea, C. oligocarpa,* and *C. virescens.* The distribution of the four other species is about evenly balanced between the two areas: *C. bromoides, C. buxbaumii, C. canescens,* and *C. lasiocarpa.* For two of the last group, *C. buxbaumii* and *C. lasiocarpa,* we have collections from only two counties for each in the state, and oddly enough, in both cases they are at Big Meadows on the Blue Ridge in Madison County and the savanna-like swales of Sussex County on the coastal plain. It is also noteworthy that Big Meadows is one of the few locales in the state for *Campanula aparinoides* Pursh. The rare collections of the marsh-bellflower all come from our mountains except one from an amazingly isolated pocket, dis-

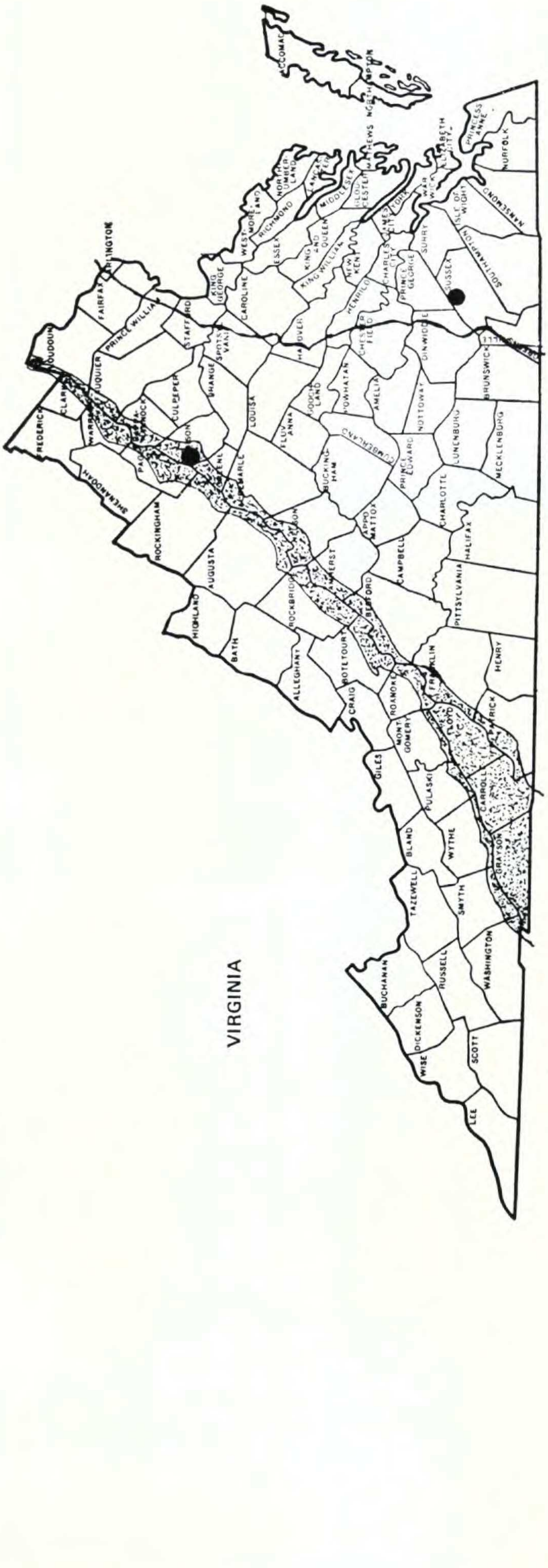

Fig. 1. Dots describe disjunct pattern of populations of *Carex buxbaumii* and *C. lasiocarpa* in Virginia.

covered by Fernald, around a sandy, sphagnous springhead almost at sea level and, again, in Sussex County. (Fig. 1).

Big Meadows is now the only station in Virginia for *Sanguisorba canadensis* L., yet, 10,000 to 12,000 years ago the Canadian burnet was a significant member of the vegetation in the Dismal Swamp area when spruce, pine, birch, alder, *Lycopodium lucidulum* Michaux, and *L. clavatum* (Whitehead, 1965) were other prominent members of this vegetation.

In his phytogeographic considerations of the coastal plain flora of Virginia, Fernald (1937) states, "Some students maintain that Coastal Plain species are moving into the ancient uplands. . . . however, it seems to me more probable that plants and animals of long-established and conservative groups should have moved out from the ancient lands . . ." Later he quotes Pennell on these disjunctions: "Certain it is that our study of the relations of the Southern Appalachians and Coastal Plain have shown that migrations may occur in either direction." Since Fernald, Pennell, and many more, in fact, considered this problem, the paleobotanical work of Craig (1969), Knox (1969), Whitehead, and others has thrown considerable light on plant migrations in this region (Harvill, 1972). These records of fossils clearly indicate that climatic oscillations of Pleistocene and Recent times brought plants migrating to and fro across the state. And it is reasonable to believe that with such climatic reversal, some species with narrow environmental tolerances would lose major portions of their ranges, whereas other species could persist in a few isolated areas where there are some unusual combinations of environmental factors. Therefore, it appears that the odd and disjunct ranges of these plants have most probably come about through the interplay between widespread climatic oscillations and local environmental conditions related to soils and sites, with both of these complexes of factors acting upon the tolerances of populations of these species which now have such discontinuous distributional patterns.

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